

GEOLOGY AND TECTONICS OF THE ARCHEAN SUPERIOR
PROVINCE, CANADIAN SHIELD;
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Although it is the world's largest relatively undisturbed region of Archean crust, Superior Province is only a remnant of a formerly more extensive craton. It is transected and surrounded by Early Proterozoic orogens which display lithological and tectonic zonation consistent with the operation of plate tectonic processes (Hoffman et al., 1982).

Superior Province has high-grade gneiss regions in the north (Pikwitonei, Minto) and south (Minnesota River Valley) characterized by granulite facies gneiss and abundant plutonic rocks. One of these (MRV) has rocks older than 3.5 Ga; absolute ages of Pikwitonei and Minto rocks are unknown but Minto does have north-south structural trends distinctive from the dominant east-west structures of the rest of Superior Province.

Between the northern and southern high-grade gneiss regions are alternating east-west trending subprovinces whose supracrustal components are dominated by metavolcanics or by metasediments. Metavolcanic-rich subprovinces (Abitibi, Wabigoon etc.) are characterized by sinuous, upright, low-grade (subgreenschist to amphibolite facies) komatiitic, tholeiitic, calc-alkalic and rare alkalic volcanic sequences with volcanogenic clastic and chemical sediments. Most metavolcanic belts consist of several lensoid, overlapping volcanic piles each on the order of 100 km in maximum dimension and approximately 10 km thick. Each volcanic pile comprises several volcanic cycles consisting of a lower komatiitic-tholeiitic basalt sequence, a middle tholeiitic basalt-andesite-dacite sequence, and an upper calc-alkalic dacite-rhyolite-andesite-basalt sequence. Chemical (iron formation, chert) and clastic (wacke, conglomerate) sediments occur within and between the volcanic cycles and, to a limited extent, as marginal aprons about the volcanic edifices. In terms of rock types, sequences, and overall configuration, Archean metavolcanic belts are most closely analogous to modern island arcs (Goodwin, 1977).

The intervening metasedimentary belts (Quetico, Pontiac, etc.) consist mainly of turbiditic wacke and pelite metamorphosed at grades ranging from low greenschist at belt margins to upper amphibolite, and locally granulite, in belt interiors. Metasedimentary subprovinces have a deceptively simple "straight" structural aspect due to strongly developed foliation, subhorizontal isoclinal folds, and gently plunging lineation. These, however, are late structures overprinted on earlier complex recumbent folds and dome and basin structures. Although data are lacking on their age, it is possible that the metasediments are broadly correlative with the adjacent metavolcanic sequences. Hence, they may represent dominantly volcanogenic detritus deposited in inter-arc sedimentary basins.

Plutonic rocks are particularly abundant in Superior Province; several subprovinces (Berens River, Winnipeg River, etc.) consist almost exclusively of felsic and intermediate plutons and orthogneiss. Plutonic rocks in the volcano-plutonic subprovinces include tonalitic gneiss, synvolcanic quartz diorite, trondhjemite and granodiorite plutons, younger granodiorite batholiths, and still younger granitic and syenitic intrusions. Peraluminous S-type granites are common

in the high-grade migmatitic parts of the metasedimentary subprovinces. Some early plutonic units may represent pre-volcanic sialic basement, but unconformable relationships can rarely be demonstrated. For the most part, the earliest plutonic rocks intrude the supracrustal rocks and commonly contain abundant, locally-derived xenoliths. The tonalitic and mafic gneisses are characterized by domal structures, in part attributable to diapirism and in part to polyphase deformation involving thrusting and recumbent folding.

U-Pb zircon dates demonstrate that volcanic, plutonic, deformational and metamorphic events of relatively brief duration were essentially synchronous over large parts of Superior Province but that there are detectable differences in ages of events from one area to another (Krogh et al., 1982). In the north (Uchi, Sachigo) major volcanism and plutonism occurred between 3.0 and 2.8 Ga and again between 2.75 and 2.7 Ga. Major deformation and metamorphism at about 2.73 to 2.7 Ga were accompanied and followed by plutonism. In the south (Abitibi, Wawa, Wabigoon) major volcanism and plutonism occurred at about 2.75 to 2.79 Ga. Here, deformation and metamorphism of the supracrustal sequences at about 2.68 to 2.7 Ga were accompanied and followed by plutonism at 2.7 to 2.66 Ga.

Dextral transcurrent faults trending EW and NW and sinistral faults trending NE form subprovince boundaries in part, as do NE and EW trending thrusts. The most notable product of the thrust faulting, the Kapuskasing structural zone, exposes granulites considered to represent lower crust brought to surface by movements on crustal-scale faults that transect the east-west trending subprovinces (Percival and Card, 1983).

In summary, Superior Province consists mainly of Late Archean rocks with Middle Archean gneisses in the south, and possibly the north. The Late Archean supracrustal sequences are of island arc and inter-arc affinity and are cut by abundant plutonic rocks, including early arc-related intrusions, late synorogenic intrusions, and post-orogenic plutons that are possibly the product of crustal melting caused by thermal blanketing of newly-thickened continental crust combined with high mantle heat flux. The contemporaneity of magmatic and deformational events along the lengths of the belts is consistent with a subduction-dominated tectonic regime for assembly of the Kenoran Orogen. Successive addition of volcanic arcs accompanied and followed by voluminous plutonism resulted in crustal thickening and stabilization of the Superior craton prior to uplift of Kapuskasing granulites, emplacement of the Matachewan diabase dykes, and Early Proterozoic marginal rifting.

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